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# Standards Conformance Testing: Issues and Activities

Sharon J. Kemmerer

U.S. DEPARTMENT OF COMMERCE
National Bureau of Standards
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U.S. DEPARTMENT OF COMMERCE, C. William Verity, *Secretary*
NATIONAL BUREAU OF STANDARDS, Ernest Ambler, *Director*

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# STANDARDS CONFORMANCE TESTING: ISSUES AND ACTIVITIES

## INTRODUCTION

**Purpose.** To provide guidance when developing a conformance testing program for a Federal Information Processing Standard (FIPS).

**Scope.** Anyone interested in developing a conformance testing program may find this document provides a starting point from which to depart.

**Background.**
Technically sound national and international standards are needed to preserve open competition in international markets and to support increased productivity and delivery of services at reduced cost. Through standards, users are provided with off-the-shelf, compatible hardware, software and communications products for computer and related telecommunications systems. Validation of these computer products claiming conformance with standards further reduces risks and uncertainties to vendors and users; uniform conformance testing procedures should be employed to perform this validation.

Conformance testing constitutes the examination of a candidate product or service for the existence of specific characteristics required by a standard. The Institute for Computer Sciences and Technology (ICST) at the National Bureau of Standards (NBS) participates in development of U.S. Government-wide standards for computer software, hardware, data management, networks and security. ICST works through voluntary industry standards organizations to develop standards that will meet the needs of Government users and be implemented in off-the-shelf commercial products. Standards that promise sizable benefits to the Government are issued as Federal Information Processing Standards (FIPS). These FIPS and the specifications they adopt are implemented into computer products for commercial use. Through past experience in research and testing, ICST sees a need for expansion of its efforts in structuring conformance testing to these FIPS, and is in the process of formulating a program.

ICST is developing an initial structure and approach for uniform conformance testing programs Government-wide for FIPS. This paper presents a conceptual framework which is modeled after such established international programs as the National Voluntary Laboratory Accreditation Program (NVLAP) and language compiler validation program; as well as the international efforts in the ISO graphics committee. This framework outlines a progression of steps needed to develop a conformance testing program for any given standard. (Although this document does not particularly address verification or acceptance testing, some of these steps may also apply for these programs.)

One of the issues needing to be addressed separately is the technical approach to program and test suite development. Another area of concern is available resources. Staff and equipment required for development, continual maintenance and updating, and all documentation are just a few considerations when developing a conformance testing program. An additional critical element impacting effective use of the given resources is timing: when does the user community need these conformance tests, and how long will it take to provide the tests using the current level of resources?

Part of each standard conformance testing program development will be recognition of the unique characteristics of each standard, such as: stability for conformance test development; level to which evaluation can be automated; "degree of completeness" of tests (when is enough, enough?); test expansion; interpretation of the standard for test development; (should tests be developed before, after or concurrent with standard development); criteria (should all tests have pass/fail results); human intervention allowed during testing; and the potential implication of excluding portions of the standard for commercial use since only selected portions of the standard may be tested.

The issues and procedures identified in this paper are among those that will be considered in developing the overall ICST Conformance Testing Program. The ICST conformance program and individual conformance tests for any given standard will evolve as more experience is gained.

**Document Organization.**
The remainder of this document is divided into two parts: Status of ICST's Conformance Testing Programs, which provides a brief summary of conformance testing programs already under way at ICST; and Conceptual Framework for Developing Conformance Testing Programs. This second part is an outlined process offering one approach for developing a conformance testing program for any given standard. Variations to this approach are assumed since testing requirements and programs will be based on the maturity and complexity of the standard, available resources, and public demand. It is broken down into the following sections:

1. Program Initiation
2. Conformance Testing Program Development
3. Testing Methods
4. Certification and Reporting Considerations
5. Testing Administration
6. Testing Laboratories
7. Mutual Recognition of Validation/Certification
8. References

APPENDIX A. Terms and Definitions

APPENDIX B. Sample Application for Testing Laboratory
APPENDIX C. Model Certificate of Accreditation

**Terms.**
Appendix A provides terms and their definitions used within the body of this report or commonly used when discussing conformance testing. They are presented to provide a common understanding from which to depart.

## STATUS OF ICST CONFORMANCE TESTING PROGRAMS

The following paragraphs provide a glimpse of initiatives in conformance test development at ICST. Various approaches were employed for a common goal: testing conformance to a standard. Some programs are more complex than others due to the varying requirements and nature of the standards themselves. Development has been completed on only a few of the programs.

**Compiler Validation.** ICST provides compiler validation for the following FIPS languages: COBOL (FIPSPUB21-2), FORTRAN (FIPSPUB69-1), PASCAL (FIPSPUB109), Ada (FIPSPUB119), and BASIC (FIPSPUB68-1)[1]. There is a fee associated with each language compiler test to recover costs since it has been a multimillion dollar investment to date. An entire ICST certification program is in place, which includes complete validating and operating procedures, and publishing a certified list of those compilers currently under certification. The quantity of tests in the test suite will vary; for example, PASCAL currently has approximately 800 tests associated with it, Ada has approximately 2600. ICST cooperates with other testing and certification authorities in the United States (e.g., Department of Defense Ada Joint Program Office), as well as internationally (France, the UK and Germany). The Federal Information Resources Management Regulations[2] requires all compilers sold to the U.S. Government must show conformance to the appropriate language FIPS.

**Document interchange.** The International Standard Generalized Markup Language (SGML) (proposed as a FIPS), requires "parsing" software to test the conformance of document type definitions and documents to the standard. SGML tools that parse SGML documents also need to be checked for completeness and ICST has developed a validation suite of test cases to do this. ICST has developed and made publicly available an SGML reference parser, an SGML validation suite, and supporting documentation. This software is available for a nominal fee from NTIS (703/487-4650). No formal certification program is in place, and ICST does not endorse or certify any product which has successfully been parsed using this software.

**Operating Systems.** The standard for Portable Operating System Interface for Computer Environments (POSIX) has been proposed as a FIPS. A reference implementation test suite is also being developed to test conformance to the FIPS. This implementation is based on the draft document being developed in the P1003.3

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1 FIPSPUBS are available through U.S. Department of Commerce, National Technical Information Service, Springfield, VA 22161; 703/487-4650.

2 FIRMR 201-8.109

Committee sponsored by IEEE. A number of companies are participating in this implementation. When completed, the source code for the test suite will be placed in the public domain. ICST is investigating the use of third party testing services, and plans to maintain and update the test suite as the standard evolves. The initial release of the subset is scheduled CY1988.

**Graphics.** An effort for the Graphics Kernel System (GKS) (FIPSPUB120) validation began in 1982 and has been funded by the Commission of the European Communities (CEC or EC). ICST has been an active participant along with Germany, the United Kingdom and France. The falsification testing methodology has been employed, tests have been developed for five separate interfaces (application, data structure, error data consistency, metafile device, and operator (user)), and ICST has provided 35 beta test sites with copies for comment. ICST has been welcomed into CEC as a potential test site for future testing of both GKS and CGM (Computer Graphics Metafile) (FIPSPUB128). A one year trial test service is scheduled to begin in 1988. Work is also progressing toward developing test suites for CGM and PHIGS, the Programmer's Hierarchical Interactive Graphics Standard (anticipated as a FIPS CY1988).

**Data Management.** The Information Resource Dictionary System (IRDS) has been the forerunner in the data management standards for initiating a conformance testing program. Currently completing the final stages of becoming a national standard, it will also be a FIPS. ICST has developed a prototype implementation of a subset of the IRDS command language; future direction includes a complete reference implementation. The prototype has been made available for vendors who are willing to provide feedback on their results. Industry is also cooperating in the development of tests. Database Language SQL (FIPSPUB127), comprised of a schema definition language and a module language which includes structured query language statements, has a validation test methodology and test suite also under development.

**Raster Compression.** In support of the Department of Defense, ICST is currently prototyping the compression and decompression of engineering drawings, for storage and transmittal, using the CCITT, Group 4 Raster Compression standard (FED-STD 1064 & 1065). The testing is demonstrating 8 1/2"x11" size drawings; ICST anticipates that a formal compression conformance testing program will be established in CY1988.

**Networking.**
FDDI. The Fiber Distributed Data Interface (FDDI) is a token ring network standard which allows up to 1000 stations in a network. ICST has established a Fiber Optic Network Laboratory, initially focusing on FDDI. A station test set and procedures were developed and a neutral, instrumented testbed for multi-vendor

fiber LAN integration testing is being established. Applying these facilities and documentation, ICST cooperates with industry for use and participation in developing commercial test equipment.

X.25. ICST developed a testing methodology for the International Telegraph and Telephone Consultative Committee (CCITT) Recommendation X.25 in 1983. The Department of Defense, Navy and Army have adopted the method, and the ICST test method is being used as a base to establish a national standard on the testing of X.25. ISO/TC97/SC6 has established a project (ISO 8882) to test X.25 terminals. Additional efforts for a conformance testing framework are underway in the international standards arena. FIPS PUB 122 provides the conformance tests for FIPS PUB 100/FEDSTD 1041.

ISDN. ICST has solicited support from other government agencies and industry, and is developing testing specifications and coordinating efforts with the Open System Interconnection (OSI) testing initiatives. Next steps include developing a standard test report format, implementing the test specifications, issuing a FIPS on the Integrated Services Digital Network (ISDN) conformance testing, developing a plan on ISDN laboratory accreditation, and attracting national and international support of the testing program.

GOSIP. ICST has developed a FIPS for the Government Open System Interconnection Profile (GOSIP) specification. GOSIP will enable Federal agencies to acquire and use OSI protocols rather than vendor-specific or proprietary protocols. GOSIP is expected to be promulgated as a FIPS in early CY1988. ICST has already developed a prototype testing network called OSINET, a global network supporting 25 industry and government organizations. This cooperative testing among vendors through demonstration participation, the availability of such an OSINET operation, and research and development activities at ICST are all initiatives contributing to the testing program development. Some of the tests have been developed by ICST; the Corporation for Open Systems (COS) is also developing tests. Organizations such as the Industrial Technology Institute (ITI) already offer testing. Overall, tests and testing programs will be evaluated by ICST for their suitability and sufficiency in meeting Federal requirements.

**Storage Media.** NBS offers for sale various standard reference materials (SRM) for evaluating the performance of magnetic storage media and systems, and for maintaining control over their production. Each SRM is individually calibrated and certified. Purchase orders for all SRM's should be addressed to: Office of Standard Reference Materials, Room B311 Chemistry Building, National Bureau of Standards, Gaithersburg, MD 20899; telephone 301/975-OSRM {6776}; FTS 879-OSRM; Telex TRT197674NBS UT.

**Security.** DES Validation. ICST has had in place a Data Encryption Standard (DES) Validation Program since 1977 which validates DES implementations for conformance to the standard (FIPSPUB46). In 1986 a Message Authentication Code (MAC) Validation System was established, based on FIPS PUB 113, Computer Data Authentication. For both of these services, ICST provides Certificates of Validation for devices which successfully pass the tests. To date, ICST has validated more than 10 vendor equipments for MAC (two of which were trans-Atlantic (UK, Denmark)), and more than 25 for DES. A Key Management Validation System which will support the testing of ANSI X9.17, Financial Institution Key Management, is anticipated to be in place in CY1988.

## CONCEPTUAL FRAMEWORK FOR DEVELOPING CONFORMANCE TESTING PROGRAMS

1. PROGRAM INITIATION

1.1. Standards Identification.
Specific FIPS and other standards being prepared for FIPS publication are currently under study as candidates for conformance testing. Considering the following will help identify those FIPS requiring a conformance testing program:

1.1.1. Is the standard straightforward so that conformance to it would be obvious and tests unnecessary, e.g., state and country codes.

1.1.2. What are the needs and scope of the user population.

1.1.3. What is the nature and content of other relevant conformance testing programs...are there already sufficient programs in place to test the standard.

1.1.4. What is the current or perceived future importance of the FIPS to commerce, or to consumer well-being.

1.1.5. What is the economic and technical feasibility of accrediting testing laboratories for the test methods, types of test methods, products, or services requested.

2. CONFORMANCE TESTING PROGRAM DEVELOPMENT

2.1. Guide for Developing a Testing Program.
The following issues need to be addressed in developing a new testing program; guidelines and recommendations to solve these issues follow in the remainder of the text.

2.1.1. If multiple test methods are currently available, establish assessment techniques and priorities to decide which test method(s) should be offered for testing.

2.1.2. Decide what the units of evaluation should be, i.e., should the test methods be offered individually or should they be logically grouped; should all test methods of a standard specification be offered as a group.

2.1.3. Identify the critical elements (environment, test equipment and apparatus, procedures), for each test method, e.g., quality assurance checks.

2.1.4. Establish assessment techniques and priorities based on the complexity and importance of each test method, e.g., should the assessor carry any instruments; should any test methods be demonstrated during assessment.

2.1.5. Determine the applicability of field testing important test methods and the means for implementing new or available field testing programs.

2.1.6. Identify selection criteria and nominate technical experts who could serve as assessors and evaluators.

2.1.7. Recommend any other special technical requirements which should be considered as necessary for accreditation in this testing field.

2.2. Application for Accreditation.

2.2.1. Any laboratory may apply for accreditation in any conformance testing program following the instructions provided in notices announcing the formal establishment of the program. Appendix B provides a sample application for a Testing Laboratory.

2.2.2. Upon receipt of the laboratory's application, the Certification Body should:

2.2.2.1. acknowledge receipt of the application;

2.2.2.2. request further information, if necessary;

2.2.2.3. confirm any payment of any fees before proceeding with the accreditation process; and

2.2.2.4. specify the next steps(s) in the accreditation process.

2.2.3. In accepting an application from a foreign-based laboratory, consideration should be given to the policy of the host government regarding the acceptance of test data from laboratories accredited by other domestic or foreign accreditation systems.

3. TESTING METHODS

3.1. Commonly accepted conformance test methods.

3.1.1. Falsification Testing. Types of standards which currently employ this method include:

3.1.1.1. programming language standards;

3.1.1.2. graphics standards; and

3.1.1.3. text standards.

3.1.2. Proofs of Correctness Testing. This is a more difficult process, but the more desired approach because of its completeness. To date, no known conformance testing program is able to offer proof of correctness.

3.2. Guidelines for development of test method approaches. The test method should be specified in a way that is easy to understand and to implement. The resulting test suite should be useful to implementors. The following steps are recommended when developing a test method:

3.2.1. Management Plan. Describes the overall scheme for the testing. It should include a specification of the technical objectives to be achieved, a description of the test strategy, and an outline of the procedures to be used for testing. This management plan should be publicly available.

3.2.2. Non-Testable Features. Although the objective is always to test all functions in a standard, there are sometimes parts of a standard which are non-testable. For example, some error conditions, depending on their nature, cannot be included in a standardized test method to check conformance. A list of all areas explicitly not tested should be available as part of the documentation of the test method.

3.2.3. Test Strategy. A full description of the test strategy to be used for the standard should be produced and made publicly available. This should include a specification of the structure of the proposed test suite, an indication of the number of tests, and an identification of the elements of the standard to be tested.

3.2.4. Test Procedures. The test method should be automated and include consideration of the procedures used to carry out testing. The setting up and execution of the test suite on a system under test, and the analysis of the output produced should be carried out in accordance with clearly defined procedures. These procedures should be documented in a manual to

accompany the test suite, and should give criteria for the analysis of all acceptable outputs for each test in the test suite. Specific assumptions for failure of test should also be stated.

3.2.5. Levels of Testing. The development of the test method should take into account all possible levels and/or options specified in the standard. The test method should allow for modularity so that tests for a specific level or option can be easily selected.

3.3. Existing test methods.
The following areas should be examined when selecting the appropriate test method:

3.3.1. Standard specification:

3.3.1.1. Definition of conditions for conformance with standards (conformance clauses).

3.3.1.2. Specification requirements. The requirements of the standard should be evaluated to identify the test method necessary for determining conformance. This method might include tests for determining that the implementation:

3.3.1.2.1. rejects illegal structures;

3.3.1.2.2. accepts data and other constructs permitted by the standards, and processes them in accordance with the standard;

3.3.1.2.3. does not include extensions to a standard;

3.3.1.2.4. properly flags usage of standard requirement options or levels;

3.3.1.2.5. processes implementation dependent specifications in accordance with the standard;

3.3.1.2.6. processes optional implementation features of the standard correctly.

3.3.2. Written test procedures supporting the test suite to identify:

3.3.2.1. test objective;

3.3.2.2. personnel responsible for test;

3.3.2.3. necessary equipment;

3.3.2.4. materials, e.g., support software;

3.3.2.5. input data;

3.3.2.6. expected output;

3.3.2.7. constraints;

3.3.2.8. required test preparation, setup;

3.3.2.9. operator actions, console setups; and

3.3.2.10. step-by-step execution instructions.

3.3.3. The test suite to see if it is:

3.3.3.1. easy to understand and manage;

3.3.3.2. portable between different hardware configurations and designed to take into account any implementation-dependent criteria allowed by the standard;

3.3.3.3. designed in such a way that there are no restrictions in using the test method or implementations on the size machine on which it can be executed.

3.3.4. Documentation Requirements for inclusion of:

3.3.4.1. description of test cases;

3.3.4.2. notation used to define test;

3.3.4.3. test method implementation/user guides; and

3.3.4.4. evaluation guides for qualifying pass, fail, or inconclusive test verdicts.

3.3.5. Requirements, if any, for specially designed test equipment training.

3.4. Test Suite Structure.
The following guidelines should be followed when writing test suites:

3.4.1. Clear documentation should be incorporated into the tests and this documentation should include:

3.4.1.1. comments, which are clear and concise. No redundant comments should be included.

3.4.1.2. a reference to the clauses in the standard which are under test.

3.4.1.3. clear statements of any assumptions made in the test suite design.

3.4.1.4. a list of any tests which are performed for information only, and will not be used to determine conformance.

3.4.2. The test suite should be split into a series of independent test programs or scenarios, such that each test program tests only one specific requirement of the specification document.

3.4.3. Each self-contained test should use the same format, and:

3.4.3.1. list all test tools necessary;

3.4.3.2. provide the testing environment data, including display of setup instructions to operator;

3.4.3.3. include program documentation section;

3.4.3.4. initialize its own workspace;

3.4.3.5. perform the test;

3.4.3.6. provide a verification section;

3.4.3.7. check whether passed/failed;

3.4.3.8. report result;

3.4.3.9. have the pass/fail path clearly defined;

3.4.3.10. include a simple comment describing the task performed by the test and a reference to the section of the standard under test; and

3.4.3.11. be kept as simple as possible.

3.4.4. Only simple features of the test support code should be used.

3.4.5. Translating the Test Suite to Other Languages. If possible and when applicable, the test suite should be written in a common format, which can then be converted, by the use of translators, to each of the programming languages. Updates to the test suites across languages must be kept in line at all times by strict use of the change control procedures.

3.5. Maintenance of Test Methods

3.5.1. Responsible Party. The Certification Body is responsible to ensure maintenance of current test methods, authorize changes, define the procedures for changes, and indicate when any changes become effective for validation purposes.

3.5.2. Procedures. A published change control procedure should be established for both the test software and the associated documentation. The change control procedures should provide a formal mechanism for the following:

3.5.2.1. reporting errors in the test software;

3.5.2.2. logging changes to the test software;

3.5.2.3. reporting errors in the documentation; and

3.5.2.4. logging changes to the documentation.

4. CERTIFICATION AND REPORTING CONSIDERATIONS

4.1. Certification Body.

4.1.1. General Requirements.

4.1.1.1. Access to the Certification Body shall not be conditional upon membership in any association or group, nor shall there be undue financial conditions to restrict participation.

4.1.1.2. The procedures under which the Body operates should be administered in a nondiscriminatory manner.

4.1.1.3. ICST will identify the members on the Certification Body.

4.1.2. Responsibilities.

4.1.2.1. Approve test methods to be used by the testing laboratories when they are not included in the standard itself. Ensure the test method is technically correct to the FIPS before using it as the basis for issuing certificates.

4.1.2.2. Collaborate with the testing laboratory in drafting a contract for testing services to include regulations which define rights and obligations in detail.

4.1.2.3. Determine accreditation criteria for testing laboratories and keep lists of all recognized to do conformance testing. Since technical requirements for laboratory accreditation are specific for each standard, technical requirements for accreditation should be developed using expert advice in that given field. Appendix C provides a Model Certificate for Accreditation.

4.1.2.4. Notify any testing laboratory that it is no longer accredited.

4.1.2.5. Issue certificates at the request of the Client, based on the certification criteria defined by the Certification Body.

4.1.2.6. When applicable, define the requirements and procedures of a Manufacturer's Declaration of Conformance Testing Program.

4.1.2.7. Define Client/testing laboratory dispute procedures. Arbitrate appeals in cases of dispute. Include procedures for disputed tests as well as disputed testing results.

4.1.2.8. Determine if there is a need for a Certified Computer Products List. If there is a need (possibly on a case by case basis), identify the maintainer and what information should be reported.

4.1.2.9. Determine what process should be followed in recognizing other published Certified Computer Products Lists.

4.1.2.10. Notify the public by advertising new conformance testing programs when the technical requirements and test methods are developed for the standard(s). Publish a notice in the FEDERAL REGISTER announcing the establishment of the

program, requirements, or methods. The notice will:

4.1.2.10.1. identify the scope of the program; and

4.1.2.10.2. advise how to request validation services.

4.1.2.11. Develop criteria and procedures for evaluating, modifying and accepting test methods for use in conformance testing to the standards. Keep in mind such test methods sources as:

4.1.2.11.1. industry;

4.1.2.11.2. government;

4.1.2.11.3. other countries; and

4.1.2.11.4. universities.

4.1.2.12. Publish the effective date for modifications to test methods.

4.2. ICST Role in Conformance Testing As Government Agent.

4.2.1. Assist and educate the agencies with regard to the scope and purpose of the test method as a measure of product quality.

4.2.2. Assist agencies in developing solicitation document requirements with regard to product testing for determining conformance to standards.

4.2.3. Identify publicity and announcement sources for informing national and international industry, Government and product users on the availability of conformance test methods and validation services.

4.2.4. Work with other government agencies, as required, to incorporate requirements within the procurement regulations (i.e., General Services Administration's Federal Information Resources Management Regulations) concerning use of conformance testing and certification of products offered to the Government.

4.3. Role of Standards Bodies (National and International).

4.3.1. Consider conformance testing aspects in the development of standards.

4.3.2. Provide advice and give technical committee or subcommittee recommendations for the approval of a test method.

4.3.3. Provide technical advice when necessary, on interpreting a standard under conflict.

4.4. Test Report.

4.4.1. Content.

4.4.1.1. Includes a complete test report and a statement citing laboratory accreditation.

4.4.1.2. Includes complete identification of system under test (SUT).

4.4.1.3. Provides a description/identification of the test environment, and any incidents contrary to routine process.

4.4.2. Format. The following guidelines should be followed when writing the software tools to produce the test program reports:

4.4.2.1. The volume of output produced by each test program should be kept as concise as possible. Tabular summaries are encouraged.

4.4.2.2. The following details should be given in the test report for each test: test number, brief description of the test, reference to the standard and implementation under test (IUT), and message indicating pass/fail/inconclusive, or not executed.

4.4.2.3. Test discrepancy summary complete enough to repeat the process.

4.4.3. Style for Test Reporting.

4.4.3.1. Each test report should provide a summary of the results giving the following information: number of tests passed, number of tests failed, number of inconclusive tests, number of "information only" tests, number of tests not executed, and total number of tests.

4.4.3.2. Wherever possible, the output of test programs should be structured in a way which is

easy to check both manually and automatically, e.g., tabular.

4.4.3.3. If test programs produce visual output on a graphics display, then this output should be kept as simple as possible to ease the checking process, while still examining all necessary features.

4.4.3.4. All tests which produce visual output should be accompanied by a comprehensive check list in the form of an operator script and a set of reference samples.

4.4.3.5. Particular care and attention should be paid to the arrangement of the test report, especially with regard to presentation of the test data and ease of assimilation by the reader. The format should be carefully and specifically designed for each type of test carried out, but the headings should be standardized as far as possible.

4.5. Certificate of Validation Format, Content and Presentation.

4.5.1. Identifies the standard(s) tested.

4.5.2. Includes a statement of the fact that the product(s) or service(s) meets the standard(s) or an applicable portion(s) thereof, clearly identifying that which is being certified.

4.5.3. Includes a clear reference to the testing laboratory and test report produced.

4.5.4. States the product name and version tested.

4.5.5. The certificate only applies to the product version operating in the SUT.

4.5.6. Certificate validity depends on the set of standards, and the specified period of time.

4.6. Applicability of Certificate of Validation on product tested. Some of the criteria to consider include:

4.6.1. The system configurations that require testing for the product for which conformance is claimed.

4.6.2. The number and type of errors discovered during testing.

4.6.3. Use of the validated product under different operating environments e.g., different hardware configurations and operating systems.

4.6.4. New software releases.

## 5. TESTING ADMINISTRATION

### 5.1. General Guidelines for Test Method Administration.

5.1.1. Test methods need to be approved by the Certification Body under technical guidance of the responsible standards committee.

5.1.2. Test methods for which conformance testing is offered are made available to everybody through adequate specified conditions.

5.1.3. Test methods offered are official for and binding on conformance testing.

5.1.4. The same test methods derived from the standards specification should be used by all ICST approved testing laboratories.

5.1.5. Test method upon which certification is based is:

5.1.5.1. acceptable to buyer or governmental regulator if mandated.

5.1.5.2. used in its entirety unless limitations are fully disclosed.

5.1.5.3. is based on a FIPS (which is based on a national or international standard) available to the public.

5.1.5.4. suitable for use as a basis for conformance testing.

5.1.6. Declaration of conformance is indicated by a statement, certificate, label or mark which:

5.1.6.1. includes information on the product, standards, producer, and procedures used.

5.1.6.2. presents clearly the intent of the declaration.

5.2. Criteria and Procedures for Alternative Testing Sources.

5.2.1. Manufacturer's declaration of conformance (Self testing). Requirements for Vendor include:

5.2.1.1. manufacturer's quality management system and documentation;

5.2.1.2. technically appropriate resources for testing and inspection;

5.2.1.3. use of a test method approved by the Certification Body;

5.2.1.4. retention of complaint records against product or service; and

5.2.1.5. any dispute resolution is in accordance with the Certification Body for that standard.

5.2.2. Third-party testing. Requirements include:

5.2.2.1. products to be tested are fully identified.

5.2.2.2. procedures by which the laboratory is operated include provision for:

5.2.2.2.1. fiscally responsible management and appropriately trained staff.

5.2.2.2.2. participation on a non-discriminatory basis.

5.2.2.2.3. resource commitment to both initial and continuing validation activities.

5.2.2.2.4. selection and retention of qualified testing and inspection services.

5.2.2.2.5. notification of participants on changes in standards and procedures.

5.2.2.2.6. confidentiality of proprietary information.

5.2.2.2.7. maintenance of records.

5.2.2.2.8. safeguarding use of official declaration of conformance.

5.2.2.3. Documentation required by the laboratory includes:

5.2.2.3.1. availability of published program directory listing products, standards, licensees, and other parties.

5.2.2.3.2. file of legally binding agreements for licensees.

5.2.2.3.3. availability of published statement of operating procedures.

5.2.2.4. Approved by Certification Body.

5.2.3. Government-managed testing. The same criteria and procedures for third-party testing would apply.

5.3. Associated Costs.
Identify costs associated with developing and maintaining conformance test methods and responsible source of funding. Typically costs associated with conformance testing will be on a cost-reimbursable basis.

5.4. Resource and overhead requirements. Examine:

5.4.1. Where and what type of facilities are required to perform validations. Considerations of competence, impartiality, and integrity are fundamental to the acceptability of the testing laboratory. Clients of the testing services must be guided by this fact in making the choice of testing laboratories that they employ.

5.4.2. What staff, equipment and office facilities are required to support a validation service.

5.4.3. What are the retention and storage requirements for validation materials, project folders and financial accounting records.

5.4.4. What is the anticipated volume of Clients and tests conducted over a year.

5.5. Criteria and Procedures for Requesting Validation Services. This section presents typical procedures which could be used for requesting and scheduling validations, and the table below provides only example timeframes associated with first time validation. These times will vary according to complexity of tests requested, and number of tests being performed.

SCHEDULE EXPECTATIONS FOR VALIDATION

| | |
|---|---|
| T - 120 | Contact approved testing laboratory, Negotiate agreement; vendor testing |
| T - 90 | Submit disputed tests, if any |
| T - 60 | Prevalidation test information/material received by the testing laboratory |
| T - 30 | Resolve all outstanding issues |
| TEST | Laboratory testing |
| T + 4-7 | Testing complete |
| T + 60 | Final Conformance Summary Report available |

Key

T = Testing Day 1; '-' or '+' = Before/Beyond Test Start

Table I.

5.5.1. Requesting validation. The Client provides the following information/material to the approved testing laboratory in a Letter of Request:

5.5.1.1. desired and alternate month of testing;

5.5.1.2. product identification, including version;

5.5.1.3. host and target configurations, operating systems, program language and other appropriate information necessary for the testing laboratory to carry out the test;

5.5.1.4. site locations and addresses;

5.5.1.5. a point of contact for validation, including full name, address, and telephone number; and

5.5.1.6. which test(s) the Client desires to take.

5.5.2. Revalidation requests. The Client requests

revalidation by the appropriate testing laboratory. The request includes:

5.5.2.1. date of current certificate of conformance.

5.5.2.2. a statement clearly confirming the computer product which is certified was not modified from the computer product described in the Conformance Summary Report.

5.5.3. Revalidating. When a modification which is beyond continuing maintenance has been made to the computer product previously certified, it should be revalidated.

5.5.4. Scheduling Validations. These times apply to the Client's responsibilities directly with the testing laboratory; the specific month in which the testing takes place is established by the laboratory.

5.5.4.1. Any prevalidation information/material should be received 60 days prior to the month of the scheduled validation.

5.5.4.2. For products not previously tested, request for validation should be submitted at least 120 days prior to the desired testing month. Data collection dates should not be established for first time validations until after a successful review of prevalidation materials has been made by the testing laboratory.

5.5.4.3. Requests for changes to an existing test date should be submitted no later than 60 days prior to that date.

5.5.4.4. Priorities. Priority is given to the scheduled annual validations. Requests from Clients for special, procurement-related validations are given second priority. Third priority is given to requests for official validation of new products. All other requests are given a lesser priority.

5.5.5. Appeal Process.

5.5.5.1. Disputed tests. If a Client believes any tests are in error, or not appropriate, the Client contacts the testing laboratory, and provides associated justification for the dispute.

A copy of this letter should be forwarded to the Certification Body as well.

5.5.5.2. The Client follows the procedures defined by that Certification Body which approved the testing laboratory for any appeals over disputed tests or disputed validation testing decisions by the Accredited Testing Laboratory.

## 6. TESTING LABORATORIES

6.1. Conditions for Accreditation. The conditions for a laboratory to become accredited and maintain accreditation depends on the testing requirements. Laboratory accreditation may require the Testing Laboratory to:

6.1.1. be assessed and evaluated initially and on a periodic basis.

6.1.2. demonstrate, on request, that it is able to perform the tests representative of those for which it is seeking accreditation.

6.1.3. pay any relevant fees.

6.1.4. participate in proficiency testing as required.

6.1.5. be capable of performing the tests for which it is accredited according to the latest version of the test method within one year after its publication or within the time limit specified by the Certification Body.

6.1.6. limit the representation of the scope of its accreditation to only those tests or services for which accreditation is granted.

6.1.7. limit all its test work or services for Clients to available capacity.

6.1.8. limit advertising of its accredited status to letterheads, brochures, test reports, and professional, technical, trade or other laboratory services publications.

6.1.9. inform its Clients that the laboratory's accreditation or any of its test reports in no way constitutes or implies product certification, approval, or endorsement by ICST.

6.1.10. maintain records of all actions taken in

response to testing complaints for a minimum of one year.

6.1.11. maintain an independent decisional relationship between itself and its Clients, affiliates, or other organizations so that the laboratory's capacity to render test reports objectively and without bias is not adversely affected.

6.1.12. report within 30 days any major changes involving the location, ownership, management structure, authorized representation, approved signatories, or facilities of the laboratory.

6.2. Criteria for Accrediting Testing Laboratories. The criteria address a laboratory's quality system, staff, facilities and equipment, test methods and procedures, records, and test reports. At a minimum following ISO/IEC Guide 25, the criteria below should be considered in order for a testing laboratory to be accredited:

6.2.1. Quality System

6.2.1.1. The laboratory should operate an internal quality assurance program appropriate to the type, range, and volume of work performed. The quality assurance program should be documented in a quality assurance manual which is available for use by the laboratory staff. The manual should be maintained relevant and current by a responsible member of the laboratory staff. A person or persons having responsibility for quality assurance within the laboratory should be designated by the laboratory management and have direct access to top management.

6.2.1.2. The quality assurance manual should contain information regarding:

6.2.1.2.1. the structure of the laboratory (organizational charts);

6.2.1.2.2. the operational and functional duties and services pertaining to quality, so that each person concerned will know the extent and the limits of his responsibility;

6.2.1.2.3. general quality assurance procedures;

6.2.1.2.4. quality assurance procedures specific for each test, as appropriate;

6.2.1.2.5. where appropriate, proficiency testing, use of reference material, etc;

6.2.1.2.6. satisfactory arrangements for feedback and corrective action whenever testing discrepancies are detected;

6.2.1.2.7. procedure for dealing with technical complaints.

6.2.1.3. The quality system should be systematically and periodically reviewed by, or on behalf of management to ensure the continued effectiveness of the arrangements, and corrective action initiated. Such reviews should be recorded together with details of any corrective action taken.

NOTE: In small laboratories, the quality system may fulfill the requirements of this clause in a simplified way.

6.2.2. Staff

6.2.2.1. Staff should have the necessary education, training, technical knowledge and experience for their assigned functions.

6.2.2.2. There should be a job description for each senior technical position category, which includes the necessary education, training, technical knowledge and experience.

6.2.2.3. The proportion of supervisory to non-supervisory staff should be such as to ensure adequate supervision.

6.2.2.4. Suitable staff should be nominated to deputize for the senior technical and quality system management staff in their absence.

6.2.2.5. Information on the relevant qualifications, training, and experience of the technical staff should be maintained by the laboratory.

NOTE: In small laboratories, one person may fulfill more than one function.

6.2.3. Testing Equipment

6.2.3.1. The testing laboratory should have access to all items of equipment required for correct performance of the tests for which it is recognized.

6.2.3.2. All equipment should be properly maintained to ensure protection from deterioration. Instructions for a proper maintenance procedure for those items of equipment which require periodical maintenance should be available.

6.2.3.3. Any item of the equipment which has been subjected to overloading or mishandling, or which gives suspect results, or has been shown to be defective, should be taken out of service and clearly labelled until it has been repaired and then shown by test to be performing its function satisfactorily.

6.2.3.4. Records should be maintained on each major item of equipment. Each record should include:

6.2.3.4.1. the name of the item of equipment.

6.2.3.4.2. the manufacturer's name and type identification and serial number.

6.2.3.4.3. date received and date placed in service.

6.2.3.4.4. current location, where appropriate.

6.2.3.4.5. details of maintenance.

6.2.4. Test methods and procedures

6.2.4.1. The testing laboratory should have adequate documented instructions on the use and operation of all relevant equipment, on the handling and preparation of test items (where applicable), and on standard testing techniques, where the absence of such instructions could jeopardize the efficacity of the testing process. All instructions, standards, manuals, and reference data relevant to the work of the testing laboratory should be maintained up-to-date and be readily available to the staff.

6.2.4.2. The testing laboratory should use methods and procedures required by the specification against which the test items are to be tested. The specification should be available to staff performing the test.

6.2.4.2.1. all manual calculation and data transfers should be subject to appropriate checks.

6.2.4.2.2. where these results are derived by electronic data processing techniques, the stability of the system should be such that the accuracy of the results is not affected. This implies an ability to detect malfunctions in the hardware during program execution and to take appropriate action.

6.2.5. Environment

6.2.5.1. The environment in which the tests are undertaken should not invalidate the test results or adversely affect the required accuracy. The testing premises should be protected as required from conditions such as excessive temperature, dust, moisture, steam, vibration, electromagnetic disturbance and interference, and should be maintained accordingly. There should be sufficient space to limit the risk of damage or danger and to allow operators to make practical and precise movements. The premises should have the equipment and energy sources needed for the testing.

6.2.5.2. Access to and use of all test areas should be controlled in a manner appropriate to their designated purpose, and entry by persons external to the laboratory should be defined.

6.2.5.3. Adequate measures should be taken to ensure good housekeeping in the testing laboratory.

6.2.6. Records

6.2.6.1. The testing laboratory should maintain a record system to suit its particular circumstances and comply with any existing regulations. It should retain on record all original observations, calculations and derived data, and the final test report for an appropriate period as designated. The records for each test must contain sufficient

information to permit satisfactory repetition of the test.

NOTE: In some countries it may be necessary to maintain records for a period specified by law.

6.2.6.2. All records and test reports should be held secure and in confidence to the Client, unless otherwise required by law.

6.2.7. Test reports

6.2.7.1. The work carried out by the testing laboratory should be covered by a report which accurately, clearly, and unambiguously presents the test results and all other relevant information.

6.2.7.2. Each test record should include at least the following information:

6.2.7.2.1. name and address of testing laboratory;

6.2.7.2.2. unique identification of report (such as serial number), and of each page of the report (sequential numbering);

6.2.7.2.3. name and address of Client;

6.2.7.2.4. description and identification of the test item;

6.2.7.2.5. date(s) of performance of test, as appropriate;

6.2.7.2.6. a statement to the effect that the test results relate only to the items tested;

6.2.7.2.7. identification of the test specification, method, and procedure;

6.2.7.2.8. description of sampling procedure, where relevant;

6.2.7.2.9. any deviations, additions to, or exclusions from the test specification, and any other information relevant to a specific test;

6.2.7.2.10. disclosure of any non-standard test method or procedure utilized;

6.2.7.2.11. derived results, supported by tables, graphs, sketches, and photographs as appropriate, and any failures identified;

6.2.7.2.12. a statement on test performance uncertainty where relevant;

6.2.7.2.13. a signature and title of person(s) accepting technical responsibility for the test report and date of issue;

6.2.7.2.14. a statement that the report should not be reproduced except in full without the approval of the testing laboratory.

6.2.7.3. Corrections or additions to a test report after issue should be made only by a further document suitably marked, e.g., "Supplement to test report serial number . . . (or as otherwise identified)," and should meet the relevant requirements of the preceding paragraphs.

6.3. Testing Laboratory Assessment. (Figure 1, below, is a pictorial explanation of the procedures which can be considered for testing laboratory assessment.)

6.3.1. On-Site Assessment. Before initial accreditation and about every two years thereafter, an on-site assessment of each laboratory is conducted to determine compliance with the criteria. Assessors use standardized checklists so each laboratory receives a fair assessment in relation to others; however, assessors have considerable latitude in judgments about each laboratory's compliance with the criteria depending on the unique circumstances of each laboratory. The assessors are selected and assigned on the basis of their expertise in the testing techniques to be reviewed. The time needed to conduct an assessment varies, but generally one week or less is the norm. Every effort is made to conduct an assessment with as little disruption as possible to the normal operations of the laboratory. The assessors:

6.3.1.1. Meet with management and supervisory personnel responsible for the laboratory's activities for which accreditation is being sought to acquaint the individuals involved and to set the assessment agenda.

6.3.1.2. Examine the quality system employed by the laboratory, its major equipment, apparatus, and facilities.

6.3.1.3. Assessors thoroughly review the laboratory's quality manual or equivalent, examine technician notebooks for records pertaining to the samples, check sample identification and tracking procedures, determine whether the appropriate conditions are maintained, and examine copies of completed test reports.

6.3.1.4. Review records of periodic internal audits, use of check samples or participation in round robin testing or other similar programs.

6.3.1.5. Review representative records including competency evaluations for all staff members who perform the tests, verification records, and sample control records.

6.3.1.6. Observe demonstrations of testing techniques and discuss them with the technical personnel to assure their understanding of the procedures. If possible the history of one or more samples from receipt to final issuance of test reports is traced.

At the conclusion of the assessment, an exit briefing is held to discuss assessment findings with laboratory management and identify any deficiencies uncovered. A written summary of all identified deficiencies is left at the laboratory. Assessment forms and a written report is submitted to ICST for further evaluation. The laboratory is asked to respond within 30 days of the date of the exit briefing and provide documentation or certification that the specific deficiencies have been corrected or that specific actions are being taken. Any laboratory applying for initial accreditation may request a delay in responding.

If any deficiencies are noted at laboratories which are currently accredited, such deficiencies must be corrected within 30 days after the exit briefing or the laboratory may face possible suspension, revocation or expiration of its accreditation. When test systems are identified as malfunctioning, they must not be used until corrective action has been completed. Any deficiencies noted for corrective action will be subject to thorough review and verification during subsequent assessments.

ACCREDITATION PROCESS

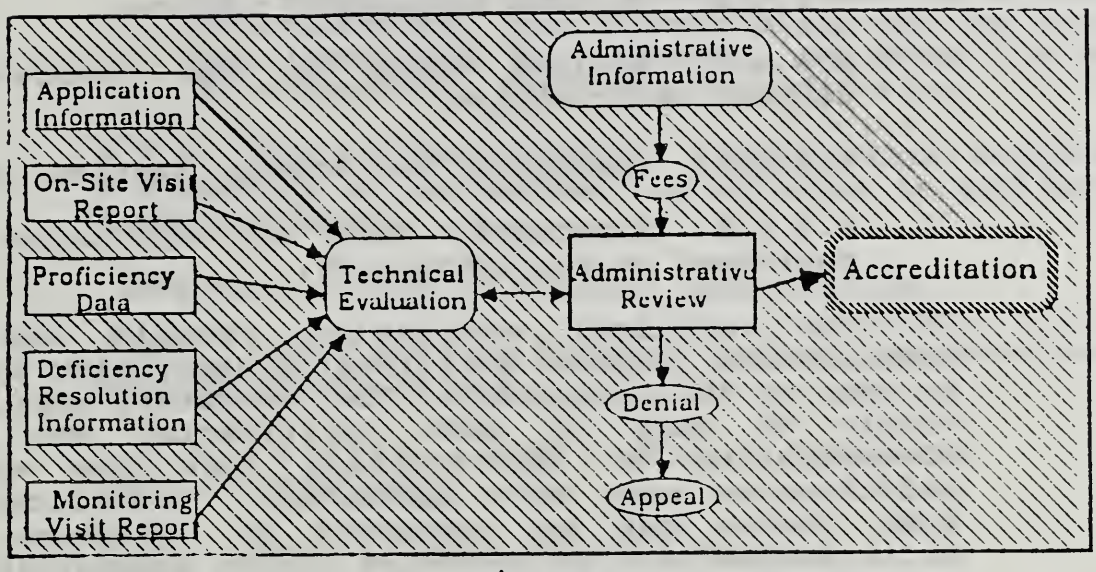


Figure 1

6.3.2. Monitoring Visits. In addition to regularly scheduled assessments, monitoring visits can be made at any time during the accreditation period. Monitoring visits serve to verify reported changes in the laboratory's personnel, facilities, and operations, or to explore possible reasons for poor performance in proficiency testing. The scope of a monitoring visit may range from checking a few designated items to a complete review. Failure to cooperate with assessors or their representatives, may be grounds for adverse accreditation action.

6.3.3. Proficiency Testing. Proficiency testing is an integral part of the ICST accreditation process. While the existence of facilities, equipment, and personnel which satisfy the criteria indicates a laboratory's overall capability to obtain good results, an analysis of actual test results for certain test methods is also necessary to determine if the overall capability does in fact produce the desired results. A laboratory's failure to participate fully in the conduct of required proficiency testing is grounds for adverse accreditation action.

6.3.4. Evaluation. Evaluation of a laboratory is conducted by ICST-approved technical experts who review records on the applicant laboratory and base their decision on:

6.3.4.1. information provided on the application;

6.3.4.2. on-site assessment reports;

6.3.4.3. actions taken by the laboratory to correct deficiencies;

6.3.4.4. results of proficiency testing; and

6.3.4.5. information from any monitoring visits performed on the laboratory.

If the technical evaluation reveals additional deficiencies, written notification describing them will be made to the laboratory. The laboratory must respond within 30 days of such notification and provide documentation or certification that the specified deficiencies have been corrected. Clarification of some issues may be requested by telephone. All deficiencies must be corrected before accreditation can be granted or renewed.

6.3.5. Accreditation Actions.
The Laboratory Accreditation Program needs to address the issues of:

6.3.5.1. Recommendation. When accreditation is recommended, the recommendation forms the basis for granting accreditation.

6.3.5.2. Denial. In cases where denial is recommended, the laboratory is notified of such action and the reasons for denial provided in writing.

6.3.5.3. Appeal. When denial has been proposed. the laboratory may request a hearing, under United States Code (U.S.C.) 556.

6.3.5.4. Renewal. Accreditation is granted for a given period of time with renewal occurring on the same anniversary date.

6.3.5.5. Termination. A laboratory may voluntarily terminate its accreditation by written request at any time.

6.3.5.6. Suspension. If an accredited laboratory develops problems or deficiencies which are of a temporary nature, its accreditation may be suspended until such time as the deficiencies are resolved.

6.3.5.7. Revocation. In cases where a laboratory is found to have violated the terms of its accreditation, the accreditation can be revoked. The laboratory may, however, be given the option to voluntarily terminate accreditation.

6.3.6. Public Notification. Accreditation actions and a directory of accredited laboratories is published on a routine basis.

6.4. Responsibilities of Testing Laboratories.

6.4.1. Carry out conformance testing and provide test reports to the Client.

6.4.2. Fulfill contractual commitment to the Certification Body.

6.4.3. Record technical test details.

6.4.4. Communicate the approved test method to the Client for conformance testing preparation.

6.4.5. Treat all test results and documents confidentially, except those which are explicitly stated as public.

6.4.6. Comply with all requirements for accreditation.

6.4.7. Comply with existing laws. Accreditation does not relieve the laboratory of the need to observe and comply with existing Federal, State, and local statutes, ordinances, or regulations that may be applicable to its operation, including consumer protection and antitrust laws.

6.4.8. Accredited laboratories are encouraged, within specified limits, to publicize their accredited status. The major restriction is that advertising must not imply product certification by ICST or the U.S. Government. (Laboratories and their Clients may not reference their accredited status in consumer media, in product advertising, or on product labels, containers, or packaging.)

6.5. Role of Certification Body in Sponsoring a Laboratory Accreditation Program.

6.5.1. Ensure the testing laboratory is accessible to anyone, including foreign Clients.

6.5.2. Ensure a model contract (e.g., order form) is available to serve as agreement between Client and testing laboratory.

6.5.3. Ensure that accredited laboratories are available to meet Client needs. Any Client requesting testing for a given standard, should be able to have his product tested within one year after his letter of request to an Accredited Testing Laboratory.

6.5.4. Establish standard-specific criteria for assessing competence of laboratories to perform testing. (Information contained in this document should assist in the generic aspects of assessment plan development.) On-site assessment can be carried out by the Certification Body or by independent assessors approved by the Certification Body.

6.5.5. Construct the test method management plan with enough flexibility to accommodate technological developments.

6.5.6. Ensure qualified technical experts, assessors and evaluators are used for accrediting a testing laboratory.

6.5.7. Ensure there are procedures for recommending the laboratory either be granted or denied accreditation. This recommendation is based on a review of the evaluation and other records to ensure that all technical, financial, and administrative obligations have been satisfied.

## 7. MUTUAL RECOGNITION OF VALIDATION/CERTIFICATION

7.1. Mutual recognition of validation.
Mutual recognition of validation is issuing a national certificate solely on the grounds of a test report, without testing anew. The layout of both test reports and certificates should be harmonized to improve mutuality among testing laboratories and certification bodies, and to ease translation.

7.1.1. Examine bilateral agreements on mutual recognition of certificates which exist for other conformance testing programs, e.g., language compilers.

7.2. Common Recognition.
To help achieve common recognition (at both the national and international level) for test methods, interface is encouraged through:

7.2.1. The certification system to provide the right for every testing laboratory to attend the testing by any other laboratory once a year in order to allow reciprocal observation for the sake of identical results.

7.2.2. Any Client worldwide, should be able to address the Certification Body.

7.3. Considerations and Issues.
Considerations and issues need to be resolved in order to achieve common recognition of validation test reports for products offered by multi-national companies who trade with other countries.

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# TERMS AND DEFINITIONS

APPENDIX A

## TERMS AND DEFINITIONS

**ACCEPTANCE TESTING.** Formal testing conducted to determine whether a software system satisfies its acceptance criteria and to enable the customer to determine whether to accept the system. Formal testing includes the planning and execution of several kinds of tests, (e.g., functional, volume, performance tests) to demonstrate the implemented software satisfies the customer requirements for the software system.

**ACCREDITATION.** The formalized initial and continuing acceptance of a testing laboratory as competent to carry out specific tests.

**APPROVED TEST METHOD.** An organized system under which, on a uniform and equitable basis, similar products or services may be certified to specified standards.

**ASSESSORS.** Selected to conduct an on-site assessment of a particular laboratory on the basis of how well their individual experience matches the type of testing to be assessed. The laboratory has the right to appeal the assignment of an assessor and may request an alternate.

**CERTIFICATE OF CONFORMANCE.** A document attesting that a product or a service is in conformance with specific standards or technical specifications as determined through use of a specified test method.

**CERTIFICATION.** The procedure by which a product(s) or service(s) becomes certified after passing tests for conformance to a standard.

**CERTIFICATION BODY.** An impartial body, governmental or non-governmental, possessing the necessary competence and reliability to operate or accredit operation of a certification system, and in which the interests of all parties concerned with the function of the system are represented.

**CERTIFICATION MARK.** The Certification Body's validating sign, symbol, or letter that identifies a product(s) or service(s) as being certified.

**CERTIFICATION SYSTEM.** A system having its own rules of procedure and management, for carrying out conformance certification.

**CERTIFIED.** Attested by the manufacturer/vendor under the procedures of an accredited testing laboratory as satisfying the requirements of the referenced standard(s).

**CLIENT.** As used in this Plan, Client refers to any organization or person who employs a testing laboratory for any purpose. Thus, "Client" can refer to a commercial organization or

Certification Body who uses the services of the testing laboratory. A Client is someone who wants products to be tested.

**CONFORMANCE CERTIFICATION.** The action of certifying by means of a certificate of conformance or mark of conformance that a product or service is in conformance with specific standards or technical specifications.

**CONFORMANCE SUMMARY REPORT.** A document written after conformance testing which records details about the IUT and the environment in which it was tested. The overall summary for the test cases executed, and, for each test case, the test purpose, analysis, and verdict.

**CONFORMANCE TESTING.** The testing of a candidate product for the existence of specific characteristics required by a standard; testing the extent to which an IUT is a conforming implementation.

**CONFORMANCE WITH STANDARDS OR TECHNICAL SPECIFICATIONS.** The conformance of a product or a service with all the requirements of specific standards or technical specifications.

**CONFORMING IMPLEMENTATION.** An implementation under test which is shown to satisfy the conformance requirements, consistent with the capabilities and options stated in the test suite pass/fail documentation.

**CONTROL BOARD.** An impartial body, governmental or non-governmental, possessing the necessary competence and reliability to approve and maintain proficient test suites for the testing program, and in which the interests of all parties concerned with the function of the tests are represented.

**ERROR.** A failure of a IUT to meet its test specifications.

**EVALUATORS.** Selected to provide a second opinion, if necessary, and to review the record including the application, assessment report, deficiencies, corrections to deficiencies, and proficiency test results and, based on this record, to recommend whether accreditation should be granted.

**"FAIL" VERDICT.** A verdict given when the observed outcome matches an outcome identified or categorized as "fail" in the test case specification.

**FALSIFICATION TESTING.** Method using sample cases that test as many of the requirements of the standard as are feasible. The test suite tries to find errors in the implementation. If errors are found, one can correctly deduce the implementation does not conform to the standard; however, the absence of errors does not necessarily imply the converse. The absence of errors implies

either that the implementation conforms to the standard or that the test suite was not comprehensive enough to find errors. Falsification testing can only prove nonconformance. (Proofs of Correctness Tests prove conformance to the standard.)

**FIELD TESTING.** Examining the test method and test suite for the quality necessary to perform a successful conformance test to the standard.

**IMPLEMENTATION UNDER TEST (IUT).** That part of a standard which is to be studied under testing, which should be an implementation of one or more characteristics of the standard.

**"INCONCLUSIVE" VERDICT.** A verdict given when the observed outcome either matches an outcome identified or categorized as "inconclusive" in the test case specification or does not match any identified outcome in the test case specification.

**IUT.** see Implementation Under Test.

**LABORATORY ACCREDITATION.** A formal recognition that a testing laboratory is competent to carry out specific tests or specific types of tests.

**MANUFACTURER'S DECLARATION OF CONFORMANCE.** The action by which a manufacturer declares under his sole responsibility, by means of a 'declaration of conformance,' that the product is in conformance with designated standards or other technical specifications, without being under the procedures of a third-party certification system. **Note:** this term is preferred over self-certification to avoid confusion with the certification process in general.

**NONCONFORMANCE.** When a product which has undergone conformance testing at an accredited laboratory does not pass the designated number of tests to qualify for conformance to the standard.

**"PASS" VERDICT.** A verdict given when the observed outcome matches an outcome identified as "pass" in the test case specification.

**PROFICIENCY TESTING** (LABORATORY). Determination of laboratory testing performance by means of interlaboratory test comparisons.

**PROOF OF CORRECTNESS.** The use of techniques of mathematical logic to infer that a relation between program variables assumed true at program entry implies that another relation between program variables holds at program exit.

**REFERENCE MATERIAL.** A material or substance one or more properties of which are sufficiently well established to be used

for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

**SEMANTICS.** The functional description, it defines precisely what must be done, but not how it is to be done (as does the syntax). Generally specified in narrative form using the English language.

**SYNTAX.** Can consist of verbs in a programming language to access the function or, in the case of graphics standards, the "bindings" to existing programming languages to access the graphics functions in the most natural way for programmers, depending on the language they are using.

**SYSTEM UNDER TEST (SUT).** The computer hardware and/or software in which the IUT resides.

**SUT.** see System Under Test.

**TECHNICAL EXPERTS.** Respected peers in their field used as assessors and evaluators, and selected through evaluation of their professional/academic achievements, experience in the field of testing, management awareness, potential for conflict-of-interest, and tact in dealing with people.

**TEST METHOD.** A specified technical procedure to determine one or more specified characteristics of a material or product. Note 1: test method includes the test software. Note 2: part of such a technical procedure may be described by statements in some programming language. The relevant software package and any hardware needed (including reference material) is understood to be part of the test method.

**TEST REPORT.** A document which presents the test results and other information relevant to the test.

**TEST SUITE.** A complete set of tests necessary to perform conformance testing for an IUT, together with the information for determining the order in which they are to be executed when in their executable form.

**TESTING LABORATORY.** A laboratory which measures, examines, tests, calibrates, or otherwise determines the characteristics or performance of materials or products. **Note:** "Testing Laboratory" in the context of this document may mean (1) a body corporate, (2) one of its subdivisions, (3) the laboratory proper (office and equipment), or (4) the testing service functions for a specific standard.

**VALIDATION.** Determination of the correctness of the program or software produced to support a specific standard or set of standards.

**VERDICT.** Statement of "pass," "fail," or "inconclusive" concerning conformance of an IUT and made with respect to a test case that has been executed.

**VERIFICATION.** The demonstration of consistency, completeness, and correctness of the product software.

## SAMPLE APPLICATION FOR TESTING LABORATORY

Appendix B

## SAMPLE APPLICATION FOR TESTING LABORATORY

1. **Applicant's name and address:**
Telephone No.:

Telex No.:

2. **Test Laboratory[3] name and address (if different from paragraph 1):**
Telephone No.:

Telex No.:

3. **Senior management**

3.1. Names and titles of the senior executives of the Test Laboratory[1] and of the testing laboratories for which recognition is being sought:

3.2. Name and title of the person responsible for the Quality Management System in the testing laboratory:

3.3. Name and title of the principal contact nominated by the testing laboratory, and of his deputy:

3.4. Operating departments of the testing laboratory for which recognition is being sought. (Show on a separate sheet to be attached either as a list or as an organization chart of the Test Laboratory[1].):

4. **Employees**

4.1. Total number in Test Laboratory[1]:

4.2. Total number in testing laboratory for which recognition is being sought:

5. **Equipment**

List on a separate sheet the major items of test equipment available for use in the area for which recognition is being sought.

6. **Test facilities and services**

6.1. List on a separate sheet the testing services for which recognition is being sought, indicating for

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[3]"Test Laboratory" refers here to the corporate entity having final authority over the "testing laboratory" seeking recognition. In some cases this may mean one of the corporate's subdivisions or the laboratory proper (office and equipment).

each service any limits between which it will operate, and the published specifications against which the testing will be performed.

6.2. If recognition by other bodies or authorities are held in the area for which recognition is being sought, please give details, e.g., subcontractor.

6.3. What type of testing is to be subcontracted in respect of the recognition being sought?

7. **Other information**

7.1. Document, where applicable, how the testing laboratory may be related to external organizations or to components within its own parent organization.

7.2. Give any other information which you consider could be of assistance to the assessment team (on a separate sheet if necessary).

8. **Quality Management Policy**

8.1. Are policy and procedures for the operation of the testing laboratory contained in a document such as a Quality Manual?

8.2. Has the person responsible for quality management the responsibility and authority to identify quality problems and initiate effective solutions?

8.3. Does the Quality Manual contain procedures for the supervision of any unqualified staff?

8.4. Is there a prescribed audit procedure for checking quality management functions?

9. **Work instructions**

9.1. Are manuals, work instructions, and regulations to be used by staff readily available?

9.2. Is there a system for updating, implementing, and recording changes to these documents?

9.3. Are documents available for each testing operation?

9.4. Are documents and reference data maintained in an up-to-date condition?

9.5. Is obsolete data promptly removed from documents, etc.?

10. **Personnel**

10.1. Have standards of professional ability, skills, and job descriptions been prescribed where necessary?

10.2. Are training methods applied to attain and maintain skills with due attention to quality requirements?

11. **Test equipment**

11.1. Does the Quality Management System specify that the equipment is of an accuracy compatible with the testing undertaken?

11.2. Is a record maintained of all test equipment?

12. **Test procedures**

12.1. Are test methods and procedures recorded which are not called up in specifications, manuals, etc.?

12.2. Are the environments in which tests are conducted and results recorded suitable to ensure their accuracy?

12.3. Do environmental test facilities exist?

12.4. Is there control of access to the testing areas?

12.5. Is there a prescribed system for detecting deficiencies in testing and their causes, and for correcting unfavorable trends?

13. **Handling and storage**

13.1. Are work and inspection instructions prescribed and implemented for the handling, storage, and return to the submitter of software and equipment?

13.2. Are appropriate storage areas arranged to prevent deterioration or damage to the products concerned?

13.3. Are storage areas accessible only to authorized persons?

14. **Records**

14.1. Is there a prescribed system for recording the method and results of testing activities?

14.2. Are observations and calculations recorded and stored as to provide a permanent test record?

14.3. Are there arrangements for ensuring that records are current, complete, accurate, and held confidential where required?

15. **Test reports**

15.1. Do test reports contain all the information required for such by ICST?

15.2. Is the testing laboratory prepared to make arrangements to send copies of test reports to ICST, where required, on a strictly confidential basis?

16. **Preparedness for assessment**

16.1. Are you satisfied that you can meet all the requirements prescribed herein?

16.2. At what date will the testing laboratory be ready for assessment?

16.3. Is there any special urgency for assessment? If so what is the reason?

Applicant's name _____

Signature and title of person authorized to sign for the Applicant_____
(Signature/Title)

Date _____

APPLICATION FOR ASSESSMENT AS A RECOGNIZED TESTING LABORATORY

Name of applicant: _____

Address: _____

_____

_____

_____

Name of Contact: _____

Title: _____

Name and address of testing laboratory if different: _____

_____

_____

_____

_____

Name of Contact: _____

Title: _____

Test or series of tests for which recognition is sought: _____

_____

_____

_____

The testing laboratory hereby agrees to:

a) conform to the requirements for a recognized testing laboratory;

b) pay any costs connected with assessment and administration in the pre-recognition stage irrespective of the eventual granting of recognition.

Signed: _____
(Title)

Date: _____

Figure 1

## MODEL CERTIFICATE OF ACCREDITATION

APPENDIX C

## MODEL CERTIFICATE OF ACCREDITATION

This is to certify the laboratory named herein has been accredited using the latest official version, version number, of appropriate standard test method; therefore the laboratory conforms to the accreditation criteria until the expiration date shown below on this certificate. This laboratory must be recertified at least once every two years, using this certificate date as the anniversary date for re-accreditation. Accreditation must occur at least 30 days prior to the expiration date of this Certificate or a new Certificate must be issued by the National Bureau of Standards, Institute for Computer Sciences and Technology by the expiration date in order to keep the accreditation of the testing laboratory in good standing and eligible for inclusion in the Accreditation Directory List for the following year.

Laboratory Name _____

Laboratory Address _____

_____

Point of Contact: Name/Phone _____

_____

Accreditation for Standard: Title/Number_____

_____

Test Method Version Number _____

Accreditation Assessment Report _____

EXPIRATION DATE _____

_____

ICST Director Signature

## INDEX

NBS-114A (REV. 2-8C)

| U.S. DEPT. OF COMM. **BIBLIOGRAPHIC DATA SHEET** *(See instructions)* | 1. PUBLICATION OR REPORT NO. NBSIR 88-3768 | 2. Performing Organ. Report No. | 3. Publication Date MAY 1988 |
|---|---|---|---|

**4. TITLE AND SUBTITLE**

Standards Conformance Testing: Issues and Activities

**5. AUTHOR(S)**

Sharon J. Kemmerer

**6. PERFORMING ORGANIZATION** *(If joint or other than NBS, see instructions)*

**NATIONAL BUREAU OF STANDARDS**
**U.S. DEPARTMENT OF COMMERCE**
**GAITHERSBURG, MD 20899**

**7. Contract/Grant No.**

**8. Type of Report & Period Covered**

NBSIR, 1980 - 12/1987

**9. SPONSORING ORGANIZATION NAME AND COMPLETE ADDRESS** *(Street, City, State, ZIP)*

**10. SUPPLEMENTARY NOTES**

☐ Document describes a computer program; SF-185, FIPS Software Summary, is attached.

**11. ABSTRACT** *(A 200-word or less factual summary of most significant information. If document includes a significant bibliography or literature survey, mention it here)*

This NBSIR suggests a process to follow when developing a conformance testing program for appropriate NBS/ICST Federal Information Processing Standards (FIPS). These FIPS and the standards they are promoting are implemented into software products for commercial use. A consistent application of testing processes and specific test suites will help align commercial products to conform to these standards. Application of such a testing process will become more critical as Federal agencies begin to request procurement of software implementing these standards.

**12. KEY WORDS** *(Six to twelve entries; alphabetical order; capitalize only proper names; and separate key words by semicolons)*

certificate; certification; certification body; conformance testing; laboratory accreditation; test method; test procedures; test suite; testing administration; validation

**13. AVAILABILITY**

☒ Unlimited

☐ For Official Distribution. Do Not Release to NTIS

☐ Order From Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

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